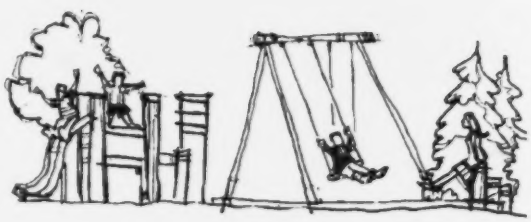
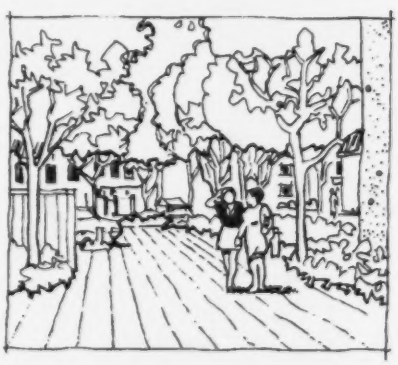
Edmonton's Suburban Neighbourhood Design Principles

FINAL REPORT





THE CITY OF Edmonton PLANNING AND DEVELOPMENT

Prepared by
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TABLE OF CONTENTS

Executive Summary 3

1.0 Background 5
- 1.1 Introduction and Purpose 5
- 1.2 The Study Process 5
- 1.3 Report Organization 6
- 1.4 Definitions 6

2.0 Suburban Neighbourhood Design Principles 8

3.0 Testing the Principles - The Redesign 25
- 3.1 Site Selection 25
- 3.2 The Plan 25
- 3.3 Impacts of the Redesign 27
- 3.3.a Land Use 27
- 3.3.b Transportation 31
- 3.3.c Transit 33
- 3.3.d Parks and Schools and Stormwater Management Facilities 35
- 3.3.e Water 41
- 3.3.f Sanitary Sewer 41
- 3.3g Storm Sewers 41
- 3.3.h Summary of Differences Between the Existing and Redesign Plans 43
- 3.3.i Front Foot Cost of Development 44
- 3.3.j Conclusions 44

4.0 Further Actions 47

Bibliography 51

LIST OF TABLES

Table 1 Options to Current Storm Water Management Practices 21

Table 2 Average Size of Population Cohorts by Dwelling Type 24

Table 3 Land Use and Population Statistics for Existing Blue Quill,Blue Quill Estates and Sweetgrass Neighbourhoods 29

Table 4 Land Use and Population Statistics for Redesigned Blue Quill, Blue Quill Estates and Sweetgrass Neighbourhoods 30

Table 5 Transportation Cost Estimates for Existing and Redesigned Neighbourhoods 32

Table 6 Scenario A - Costs to Assemble and Develop Park and School Lands as they Exist 38

Table 7 Scenario B - Cost to Assemble and Develop Park, School and Storm Water Management Lands if they were Planned in 1995 using Current Standards 39

Table 8 Scenario C - Cost to Assemble and Develop Park, School and Storm Water Management Lands as Proposed in the Redesigned Neighbourhood 40

Table 9 Water Cost Estimates for Existing and Redesigned Neighbourhood 42

Table 10 Costs per Front Foot 46

FIGURES

Figure 1 Location of Selected Neighbourhoods in SW Edmonton 26

Figure 2 Existing Sweetgrass, Blue Quill and Blue Quill Estates 28

Figure 3 Redesigned Sweetgrass, Blue Quill and Blue Quill Estates 28

Figure 4 Transit Walking Distance Map 34

Executive Summary

The purpose of the Suburban Neighbourhood Design Project is twofold:

- to review the design of neighbourhoods to make the infrastructure more cost efficient while maintaining a good living environment, and
- to generate thought, discussion and general principles which encourage flexibility and innovation in the design and servicing of new neighbourhoods.

This report is a summary of work done to date on the first purpose with further actions which it is hoped will generate further thought, discussion and innovation.

With respect to the second purpose, the activities leading up to this summary have generated a great deal of thought and discussion and 16 general principles to guide the design of suburban neighbourhoods. It has served to encourage the project participants to take a more flexible and innovative view to the design and servicing of new neighbourhoods.

The intent is not to simply reduce infrastructure costs for the development industry and the City but to optimize use of capital resources given the current environment of grant cuts, budgetary restrictions and the housing market.

The general principles can be applied in many ways not exhibited in this report and with more flexibility and innovation can probably result in greater cost efficiencies while providing a good living environment.

It is now incumbent upon those in the public and private sector responsible for the design, servicing, construction and marketing of new Edmonton neighbourhoods to work with the start that is exemplified by this project to continue to review standards, levels of service, and innovative ways of providing neighbourhoods that Edmontonians wish to live and grow in.

It is hoped that this report is not an end but a beginning that will spur continuing review and innovation.

1.0 Background

Funding for infrastructure to support continuing growth in Edmonton is limited. The elimination of many provincial grants; the City's commitment to it's debt management strategy; and, ageing and sometimes insufficient downstream infrastructure make it increasingly difficult to support new suburban communities. A different outlook on neighbourhood design and service standards for new neighbourhoods is required.

Recognizing these problems, the City administration is considering many issues relative to alternative funding; review of service standards; and, land use strategies for the downtown, inner city and suburban residential and employment areas.

1.1 Introduction and Purpose

This report summarizes one component of the infrastructure review - the design of suburban neighbourhoods. The purpose of the project is twofold:

- to review the design of neighbourhoods to make the infrastructure more cost efficient while maintaining a good living environment, and
- to generate thought, discussion and general principles which encourage flexibility and innovation in the design and servicing of new neighbourhoods.

The intent is not to simply reduce infrastructure costs for the development industry and the City but to optimize use of capital resources given the current environment of grant cuts, budgetary restrictions and the housing market.

1.2 The Study Process

In the spring and fall of 1994, a working group from various City departments, the Public and Catholic School Districts, the development and consulting industry and the Urban Development Institute (UDI) was formed. The group met on numerous occasions to review the way in which suburban neighbourhoods are currently designed. From this review, it was able to generate draft Suburban Neighbourhood Design Principles which reconsider land use and servicing requirements. A working paper was prepared dated January 1995 summarizing the issues and proposing the draft principles. Steps to test and implement the principles were also outlined in the working paper.

Beginning in March of 1995, the working group chose 3 fully developed suburban neighbourhoods and redesigned them by applying the draft principles, proposing revisions to land use organization, standards and "quality of life" considerations. The existing design and the redesign have been costed and compared to determine what cost savings are achieved. A more qualitative assessment has also been undertaken. As a result, the draft principles have been revised and expanded upon in this report.

An open house was held with the Urban Development Institute membership in June 1995. It's purpose was to tell the membership more about the project and to solicit input regarding design and marketing components of the project. This input has been considered in the preparation of this final report.

UDI has had a member on the working committee and has provided review and input to the final report.

The Edmonton Federation of Community Leagues was provided with an opportunity to review the draft final report and provide input to its completion. No concerns or comments were received.

A review of current planning philosophies across Canada and the United States was also undertaken to investigate how other cities have been dealing with changing servicing standards and strategies for sustainable communities. This information was used in the working group discussions, the development of the Principles and the completion of this report.

The further actions outlined in Section 4 include follow up actions and activities to be undertaken in order to implement the principles and continue to generate thought and discussion toward flexibility and innovation in the design and servicing of neighbourhoods.

This report is oriented toward servicing and quality of life issues. It can form a solid basis for further work toward issues of sustainability at the neighbourhood and community level if city wide policy directives embrace sustainability and support sustainable suburbs.

1.3 Report Organization

Section 2 provides a discussion of the Suburban Neighbourhood Design Principles.

Section 3 provides a discussion of one application of the Principles developed to test their effectiveness.

Section 4 includes future actions to be undertaken to progress from this theoretical review of suburban neighbourhoods to a real change in Edmonton's suburbs.

1.4 Definitions

Throughout the document, a number of terms are used repeatedly which require a common understanding among readers. Following are definitions of some of those terms.

1. A Neighbourhood is a grouping of residences housing 3,000 to 5,000 residents complemented by shared infrastructure such as collector roadways and drainage facilities and by shared facilities such as schools, parks, community league buildings and/or commercial sites.

2. A Community is two or more neighbourhoods which share infrastructure and a broader range or magnitude of facilities including those typical of neighbourhoods as well as churches, libraries, business ventures, expanded commercial opportunities, drop in centres, seniors facilities and/or a variety of schools.

3. A Catchment Area is the portion or portions of a neighbourhood or community needed to support a particular facility or institution. Catchment areas will vary for different types of facilities. For example, the catchment areas for an elementary school, library, church or commercial site will all vary both in size and boundaries.

4. In this report, Infrastructure refers generally to "hard" services such as roads, sanitary and storm sewers, water, and walkways. While schools and parks form part of the infrastructure of a neighbourhood or community, they are included as "facilities" for these purposes.

5. Facilities include educational, institutional, recreational, commercial and business uses.

6. Focal Point is a grouping of facilities and infrastructure within a common geographic location which acts as a destination point for a variety of purposes to serve a neighbourhood or community.

2.0 Suburban Neighbourhood Design Principles

Following is a discussion of each of the Suburban Neighbourhood Design Principles proposed to guide development of future Edmonton suburbs. In each case, the principle is stated followed by a discussion of its purpose and applicability.

Design Principle 1

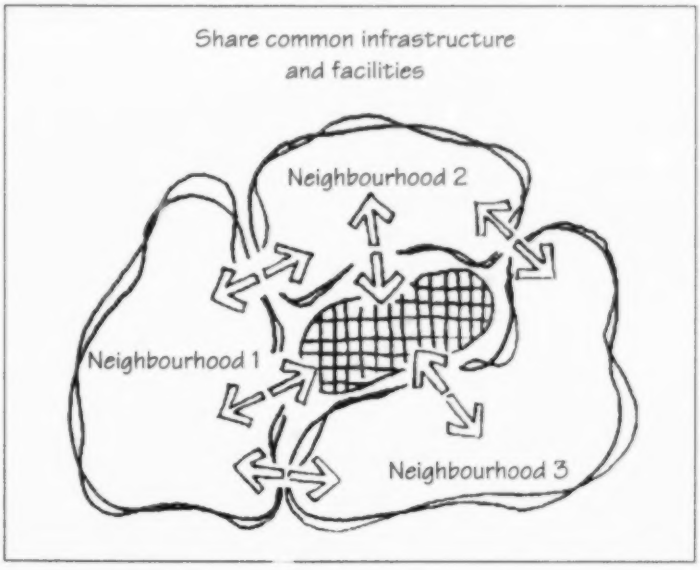
Design neighbourhoods with the intent of sharing common infrastructure and neighbourhood facilities among neighbourhoods.

Discussion

Planning common infrastructure such as roads and drainage facilities to be shared between neighbourhoods allows for an overview of servicing requirements at a larger scale than the single neighbourhood. It provides options for the service delivery. It provides better integration of neighbourhoods through such things as circulation systems, open space and stormwater management facilities. It provides opportunities for a more cost efficient provision of services to appropriately sized catchment areas.

Contemporary planning theory promotes the idea of focal points conveniently located within a "community" (several neighbourhoods) with smaller focal points included at the neighbourhood level.

Designing several neighbourhoods to focus on a community centre, combining such things as public institutions and convenience retail needs, provides sufficient population to support a variety of facilities which may not be supported at the neighbourhood level.



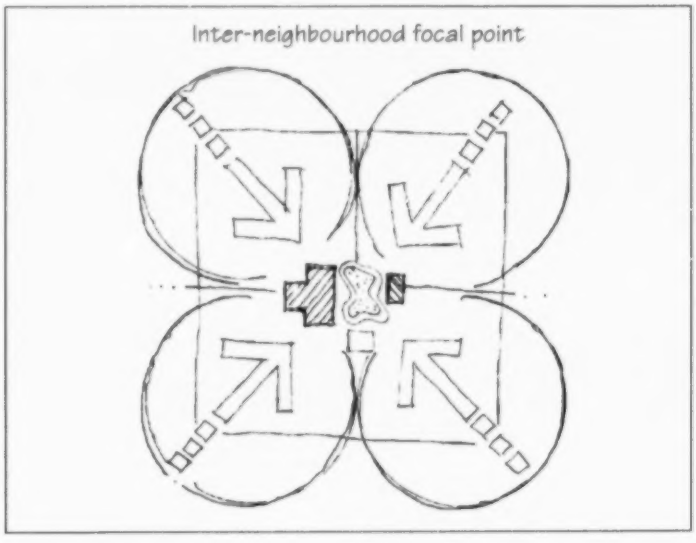
Design Principle 2

Design and locate school and community facilities to provide inter-neighbourhood focal points.

Discussion

In planning the location of schools, the catchment area size is as important as the neighbourhood size and boundaries. Catchment areas for schools built by the Catholic School District often include several neighbourhoods. Catchment areas for Public School District schools may include more than one neighbourhood. Therefore, locating schools central to the catchment area rather than to a neighbourhood makes sense. Combining schools with other uses such as community leagues, play fields, churches, libraries, business ventures, drop in centres and seniors facilities may also have long term cost saving implications. It provides a community destination with a multitude of uses and users. This concentration of uses becomes a catalyst for including retail commercial opportunities in the community focal area due to the number of people drawn to the focal area.

This is not to say that a focal point must contain all schools or other uses in one location. The catchment area for each use may vary in size. However, where possible, complementary uses should be located in close proximity to create a critical mass of uses which will act as a focal point.



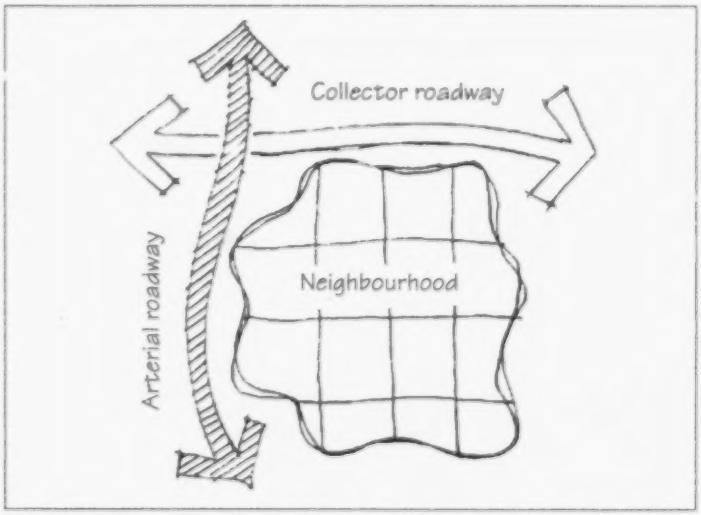
Design Principle 3

Design the arterial and central collector roads along a grid pattern, peripheral to the neighbourhoods. Use local roadways to distribute neighbourhood traffic from/ to these arterial and collector roadways.

Discussion

By keeping higher volumes of traffic to the periphery of the neighbourhood and by locating the inter-neighbourhood focal point towards the edge of the neighbourhood, as discussed in Principle 2, the need for higher volume internal roadways can effectively be eliminated. The neighbourhood can still remain somewhat insulated from excessive vehicular traffic on local streets. More local streets accessing this grid based arterial/collector system provide more opportunities for access to and egress from the neighbourhood. This distributes neighbourhood traffic on a multitude of streets rather than a few focused points that all traffic must use. A variety of routes for moving around within the neighbourhood is also provided.

This redistribution of traffic allows for different standards of roadway to be used within the neighbourhood. For example, the need for the looping collector prevalent in many Edmonton neighbourhoods is eliminated. This collector road has traditionally been built with a wider carriageway on a wider right of way. There is little fronting on development in order to accommodate the traffic volumes being carried to the limited accesses into and out of the neighbourhood. This type of roadway forms a barrier to neighbourhood cohesiveness due to its width, traffic volumes and speeds. It is a major cost to the development industry as a non-revenue roadway in the sense that few residences front onto it. By diminishing the need for this type of road, costs can be reduced by building narrower roads. Roads can become residential streets with "ownership" by the residents. Further, by distributing traffic over more roads, local road standards can also change to cater to all mobility modes.



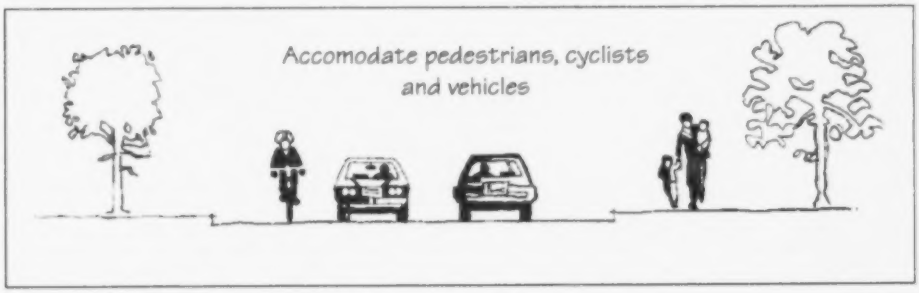
Design Principle 4

Design neighbourhood streets (both neighbourhood design and cross section of roadway) with standards that cater to the main intended use of the road.

Discussion

Streets should be designed to cater to their intended purpose. Local residential streets should be designed to accommodate pedestrians, cyclists and vehicles while considering the type and intensity of land use along the road. The width of the road should bear a direct relationship to the scale of abutting development - not just the level of vehicular traffic it might occasionally carry.

A neighbourhood road system should provide ease of access throughout the neighbourhood for pedestrians, cyclists and vehicles. Residents should be able to travel to destinations within the neighbourhood by different routes feeling safe and comfortable no matter what mode of travel is chosen. Routes throughout the neighbourhood should be convenient for pedestrians without unnecessary long detours around residential blocks. This should be accomplished in a safe fashion through the use of the road system and a safe, well designed open space walkway system.



Design Principle 5

Provide convenient pedestrian and bicycle access throughout the neighbourhood and especially between destination points within and outside the neighbourhood.

Discussion

Sidewalks are needed throughout the neighbourhood on both sides of all streets in order to accommodate and encourage pedestrian circulation within and out of the neighbourhood. Landscaped boulevards are needed to enhance the enjoyment of walking to destinations. Bicycle traffic can be accommodated on the local roads as well as on strategic bike paths through rights-of-way, parks and public utility lots. If street right-of-way widths and design standards reflect the intended use of that road, this requirement will not be onerous either in the amount of land needed or in construction costs incurred.

It is important to note that Principles 3, 4, and 5 must work hand in hand. For example, it is not acceptable to substitute the City's current servicing standards with ones which simply narrow roads as a cost and land saving measure. A neighbourhood road design and road standard that accomplishes the goal of better mobility for all modes of travel within the neighbourhood must also be provided.

Better pedestrian and bicycle access

Design Principle 6

Provide Transit Services to the edges of new neighbourhoods using the arterial and collector roadways in conjunction with appropriately designed, strategically located and conveniently accessed transit waiting zones.

Discussion

Smaller neighbourhoods accessed by a grid based collector and arterial roadway system have the ability to provide this type of transit service. The community focal points discussed in Principles 1 and 2 further enhance this approach by providing transit close to daily needs and within a reasonable walking distance of homes. By locating medium density residences and schools at the inter-neighbourhood focal points and at the edge of neighbourhoods they can be conveniently served by nearby Transit. A well designed local roadway and open space system accessible in all seasons will aid in providing reasonable walking distances between homes and the transit stops on the edges of neighbourhoods.

Local streets will not be designed to accommodate large bus traffic. If internal bussing is needed, smaller vehicles will need to be considered. This may be a concern during the developing years of a neighbourhood if children need to be bussed to schools outside the catchment area.

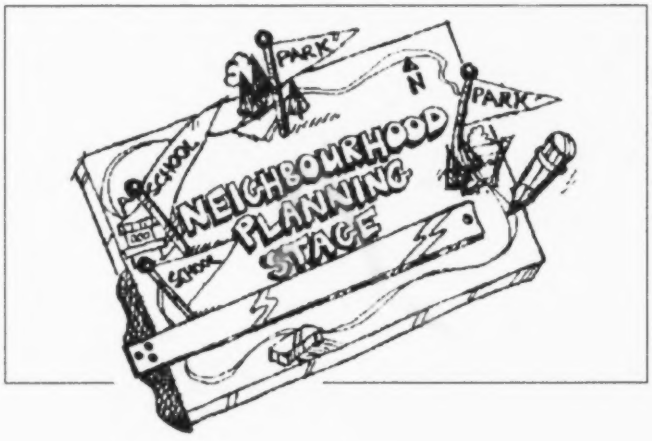
Convenient transit waiting zones

Design Principle 7

At the area and neighbourhood planning stage, plan the location of school/park facilities relative to neighbourhood staging such that they can be consolidated, serviced and available early in the development of a neighbourhood or catchment area.

Discussion

School/park sites should be located such that they can be consolidated, serviced and available early in the development of a neighbourhood or catchment area. They can then be developed as the contributing neighbourhoods need them. Park space should be developed earlier rather than later and serve as an amenity to the neighbourhood or catchment area as it develops. There may also be some surveying, registration and districting cost savings if the school site is consolidated early in the neighbourhood development.

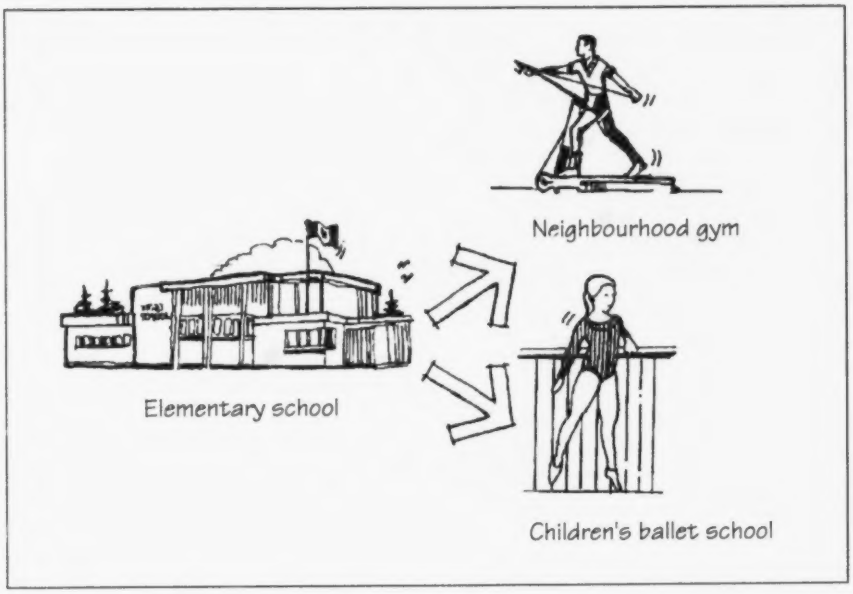


Design Principle 8

Design park and institutional sites and buildings within the neighbourhood and community focal points to be adaptable to other uses or levels of education over time.

Discussion

Neighbourhood plans should recognize from the outset that suburban neighbourhoods will age and eventually become old suburbs or inner city neighbourhoods. The services and facilities needed by the residents will also change as this ageing occurs. Therefore it is not only important to design a focal point for the developing neighbourhood and community that provides a variety of attractions. The sites and buildings must be adaptable to changing needs and uses.



Design Principle 9

Explore opportunities to provide smaller, dispersed open space and parks in a neighbourhood to provide for localized needs while meeting the recreational needs of residents of the catchment area.

Discussion

Successful neighbourhoods with a sense of community do more than just provide housing units. Small focal points in the neighbourhood where people can gather and children and adults can play and interact enhance the sense of community. Pedestrian friendly streets at a scale suitable to the adjacent residences can satisfy some of this need. Small, dispersed open spaces can augment it by providing local destinations and activity areas. Depending on the type and design of storm water management facilities and other rights-of way, they may be incorporated into the neighbourhood as part of the dispersed open space system.

A range of innovative ways to fund maintenance costs associated with dispersed parks will be sought.

Parks and open space

Design Principle 10

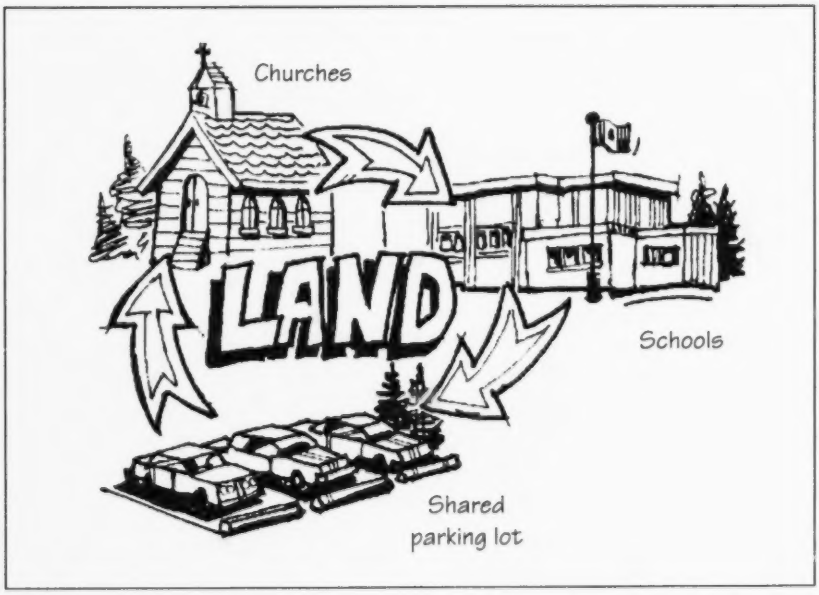
Optimize the use of land and capital requirements for facilities such as churches, schools, community leagues and storm water management.

Discussion

Opportunities exist to share aspects of these uses. Examples include:

- share parking between churches, schools, community leagues and play fields as they seldom have peak use at the same time
- provide schools and community leagues under one roof to save land, share facilities such as libraries and gymnasiums between school boards and community leagues, and reduce operating and maintenance costs
- provide for dual use of land for play fields, passive naturalized parks and storm water management to save land and capital development costs while providing adequate play fields outside the major storm events
- share play fields for school and community needs to save land and maintenance costs since they are seldom used at the same time (already widely used in Edmonton).

These examples could reduce capital development costs for all uses. Maintenance costs could be reduced and shared. Municipal Reserve resources can be freed up to provide cash or land for further dispersed open space or for park development to benefit the neighbourhood.



Design Principle 11

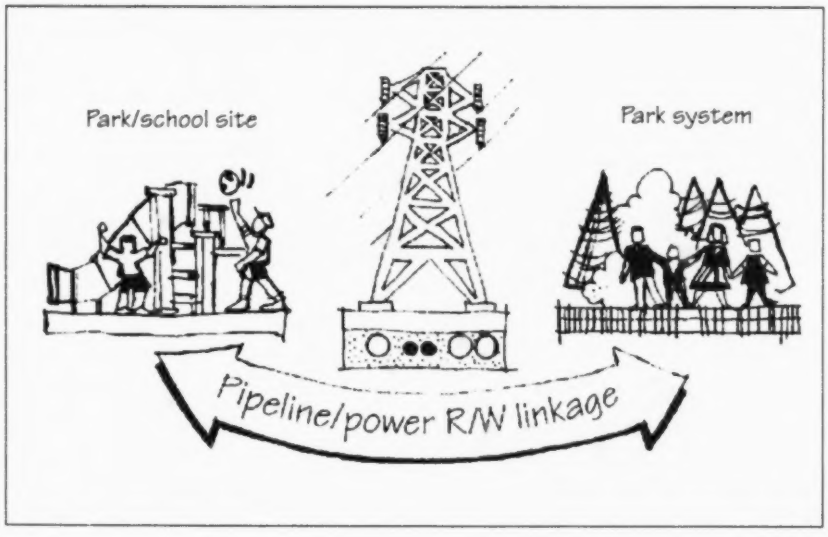
Create a linked open space system through open spaces created by storm water management facilities, some utility rights-of-way, preservation of appropriate natural areas and drainage courses, and school and park open spaces.

Discussion

Linking open space features throughout the neighbourhood is an important feature in making the neighbourhood more attractive and increasing mobility for residents. It can also have potential educational value for local schools. Linking of the sites does not have to occur solely through the use of open space and walkway features. Linkage by roadways with sidewalks is also acceptable and has the additional benefit of providing increased surveillance of the open spaces from roadways.

The recognition of areas required for utility purposes as useable open space allows for a more open neighbourhood without the need to dedicate all Municipal Reserve resources for land acquisition. Subsequently, MR dedications can be provided as cash-in-lieu and used for the earlier development of the park facilities. Shared park/utility lands also provides an opportunity for a greater sharing of open space development costs between the public and private sectors.

Preservation of natural areas and drainage courses is important to the ecosystem and can provide an amenity to the neighbourhood. Edmonton's policy "Conservation of Natural Sites in the Table Lands" provides direction in how this can be accomplished at the new neighbourhood level.



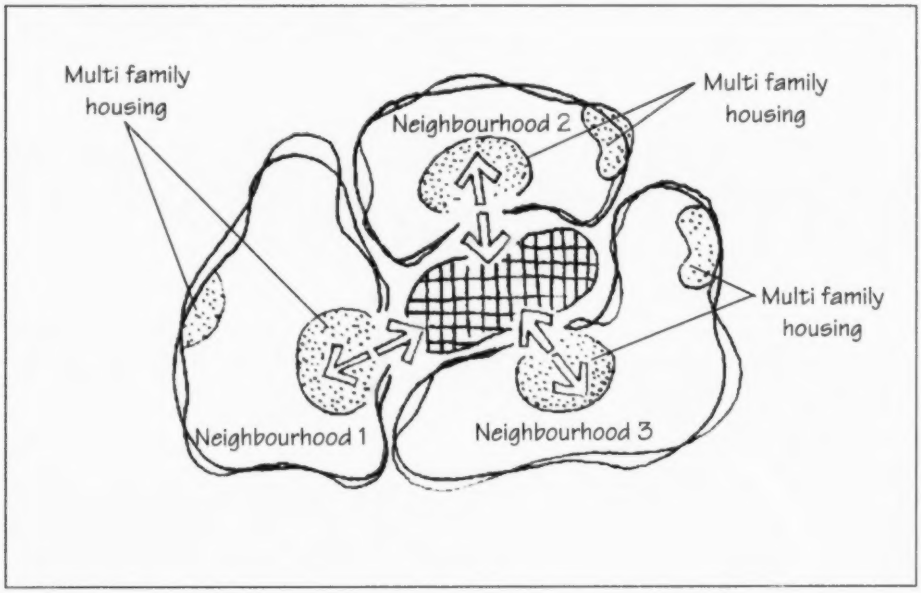
Design Principle 12

Locate multi family uses toward the edge of new neighbourhoods and close to the community and neighbourhood focal points.

Discussion

Multi family land is generally developed more intensely than lower density residential uses. This more intense population base can provide a larger population in close proximity to transit and all of the uses identified for the focal points. This provides more opportunity for success of those uses as well as amenities which may not be available on the actual residential site.

Multi-family developments also require a greater level of servicing as far as roadways, sewers and water lines are concerned. By keeping these higher density uses towards the edges of neighbourhoods, cost savings may be realized by eliminating the need to oversize pipes and roadways greater distances into the neighbourhood.



Design Principle 13

Use stormwater management techniques which provide an alternative(s) to the man made lakes and dry ponds typical to Edmonton.

Discussion

Storm water is generally managed through man made lakes or dry ponds. More recently, wet lands are being constructed or converted for the same purpose. A number of other options should be considered. A "dual use" site, as mentioned in Principle 10, where storm water management facilities and play fields are located on the same land is one example. Others worth pursuing include:

- greenway ditches/trenches (no curb and gutter)
- percolation
- decentralization of storm water management
- use of pervious pavement for streets
- require use of more pervious surfaces on private property
- narrower access roads to individual homes

Table 1 provides a description and questions and issues for each of these options.

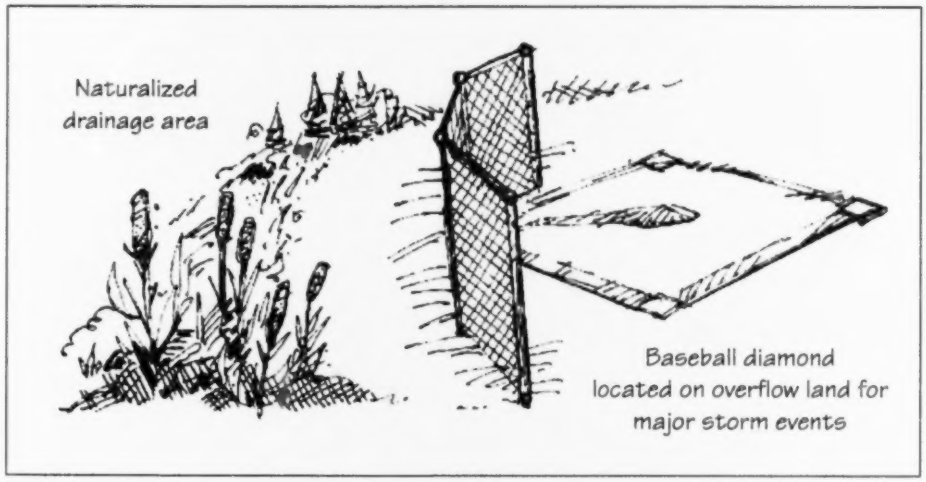


Table 1 Options to Current Storm Water Management Practices

Options	Description	Questions	Issues
Greenway Ditches/Trenches (no curb and gutter)	A grassed area dedicated to providing collection and conveyance of stormwater drainage. Located along the front or the back of a property and through PULs or easements or as part of the road right-of-way.	• Should the greenway be on public or private property? • Who will be responsible for operation and maintenance of the area? • What level of operation and maintenance is required? Would Parks & Recreation be responsible for operation and maintenance? • Can it be integrated into the City's park system or walkway system? • Who will monitor level of operation and maintenance? • How is roadway drainage managed? Will this influence/alter roadway drainage? • If the greenway is located at the back of properties, how would the Drainage Branch ensure no encroachment occurs?	• Insufficient grade on rear lot swales currently results in ponding on some properties. • Do not want to exchange cheaper construction cost for higher operation and maintenance costs. • Design a linear SWM facility weaving its way through the neighbourhood. • Have to ensure no encroachment occurs in greenway. Requires enforcement of drainage easement. • Would improve water quality of runoff. • Public may perceive it as unfair to pay similar tax rates for areas without an underground storm sewer system. • Provides additional argument for a storm sewer utility.
Percolation	A grassed area dedicated to providing stormwater drainage with a subsurface perforated drainage pipe to ensure all flows are removed from the area.	• Can percolation system be a shallower, smaller pipe system? • How would spring/fall freeze/thaw be dealt with? • Would the freeze/thaw cycle cause cracking of the perforated pipe? • What about long term operation? Will the system require replacement in 25 years due to clogging of the filtration fabric/perforated pipe? • Could roadway grassed medians be used for this option?	• Contractor/Developer may have to dig a second trench depending on location of the system. Currently dig only one trench to accomodate both sanitary and storm sewer. • May be easier to maintain if located in front of the property (boulevard) giving access from the roadway for operation and maintenance. • Design neighbourhoods to promote better use of natural gradients. • Technical feasibility in Edmonton's climate and geology is questionable
Decentralization of SWM	Detain runoff in a number of smaller ponding areas and reduce the size of the centralized pond that discharges to the storm sewer system. This would allow for a faster completion of ponds by requiring fewer stages for development. This option could be implemented in conjunction with the greenways. Possibly retain water in on-lot storage tanks and reuse on site.	• What degree of decentralization is appropriate/cost effective? • What is an acceptable level of safety?	• Need to identify an acceptable level of service to property owners. This would be based on public perception of ponding sites. • Could throttle the sewer system now by modifying inflow at catchbasins and ponding runoff on the roadway. • Downstream properties may experience problems from cumulative upstream runoff. A property owners inattentiveness to their property may result in significant wetting of other properties. • Ponding areas may be continuously wet, resulting in cattails, mosquitoes, flies, etc. Need to have a subdrainage system to ensure complete drainage of area or sufficient slope and maintenance to ensure proper operation.
Use of pervious pavement for streets Require use of more pervious surfaces on private property	Design roads with pervious surfaces (i.e. change road pavement design) Require driveways, etc. to be made with open paving stones or rock	• Would this be publicly acceptable? (Weeds in roadway, etc.) • Would this be acceptable and cost effective as a roadway structure? • How would this affect the City's snow removal costs?	• Use paving stones that promote infiltration of runoff • Requires a good subsurface drainage system to prevent heaving during freeze/thaw cycle. • During major storm events significant runoff will still occur.
Narrower access roads to individual homes (no on-street parking in front of homes)	Provide a common site for on-street parking of vehicles to reduce the impervious surface in a residential area. Have houses arranged with walkways similar to a multifamily site.	• Would this be publicly acceptable? • What is an acceptable distance for people to walk during winter with many bags of groceries? • Are on-lot driveways and garages to be permitted? • Will Roadway Operations accept reduced road widths?	• May be attractive to only a specific segment of the public.

Design Principle 14

Minimize the use of public utility lots and maximize the use of easements for underground services not located in road rights-of-way.

Discussion

Public utility lots sterilize land and pose ongoing costs to the City either through direct maintenance costs or administrative costs to lease the land to adjacent property owners. Ideally, underground utilities should be provided in road rights-of-way. Where this is not possible, easements would protect the utilities and automatically make the property owner responsible for the surface area without the additional leasing costs to the City and the property owners. Current City Bylaws prohibiting the use of such easements will need to be reviewed.

Design Principle 15

Provide opportunity through the residential districts of the Land Use Bylaw for the intensification of housing forms and for alternative site design and building siting.

Discussion

If streets are designed for their intended purpose as stated in Principle 4 taking into account the scale and type of development, siting of buildings through reduced setbacks and reduced onsite impervious surfaces can save land, reduce construction costs, reduce flows during storm events and enhance the amenity the streetscape can provide.

Cluster housing and housing oriented toward open space and attractive walks may also reduce land requirements, construction costs, stormwater effluent and provide an attractive environment. This should be done without isolating a cluster housing area through fences, walls or turning its back on the rest of the neighbourhood.

These options are presently difficult to pursue due to current engineering standards and restrictions under the Land Use Bylaw. Review and revision is necessary.

Alternative site design and building siting

Design Principle 16

Use current population projections and student generation formulas when planning facilities for a neighbourhood. Take into account the life cycle of the neighbourhood.

Discussion

Historically, Edmonton neighbourhood population projections are based on the maximum density allowed under the districts applied through the Land Use Bylaw. A review of selected neighbourhoods throughout the City indicates that townhousing is often built out close to the maximum (42 upha) allowed in the Land Use Bylaw. Low rise apartments rarely come close to the maximum (125 upha) allowed density. Single family development is usually below the maximums allowed under the bylaw as minimum lot sizes have not traditionally been used throughout a neighbourhood.

Likewise, the number of people living in a unit and the number of students generated by a unit must be reviewed from time to time. To confirm people per unit and student generation numbers, a sample of approximately 76,000 households in the RF1, RPL, RF4, RF5/DC5, RA7 and RA8 districts of the Land Use bylaw from suburban neighbourhoods built between 1970 and April 1993 was examined. The results summarized in Table 2 should be used in estimating neighbourhood population and student generation.[1]

Life cycle theory states that a neighbourhood progresses through several growth stages which impact its demographic profile and the average number of people in various age groupings (and therefore overall neighbourhood population) as the neighbourhood builds out and matures. It considers the fact that not all units in a developing neighbourhood are occupied at the same time. Therefore residents will not all need the same facilities at the same time. This is particularly important in projecting school and recreational needs.

In recognition of this, a computer model has been created which accounts for various build out scenarios and incrementally ages the population through the development of a neighbourhood. This, combined with the revised generation statistics discussed above should allow a more accurate projection of neighbourhood population and student generations and therefore school facility and timing needs.

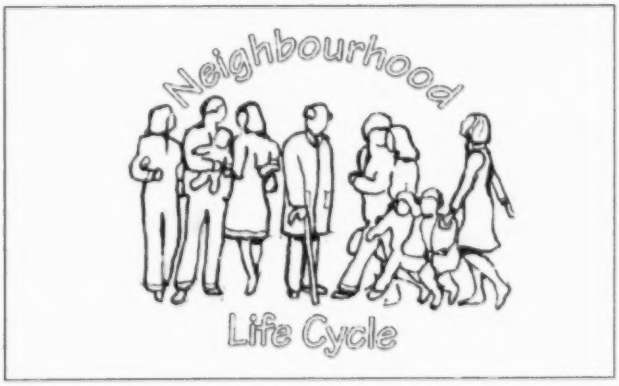


Table 2 Average Size of Population Cohorts by Dwelling Unit Type

Data as of May 1993
Source: SELUS

Single Detached in RF1 Land Use District

Period of Construction	Sample Size (# of Units)	Average Household Size	Average size of age cohorts per unit: Pre-school children	Elementary students	Junior High students	Senior High students	Average Number of Pre-Schoolers & Students per Unit
1990's	2418	3.65	0.30	0.49	0.22	0.24	1.25
1985-1989	3264	3.67	0.41	0.59	0.18	0.17	1.35
1980-1984	9489	3.65	0.36	0.65	0.21	0.16	1.38
1975-1979	20369	3.52	0.25	0.51	0.22	0.21	1.19
1970-1974	4199	3.37	0.20	0.38	0.19	0.23	1.00
All Periods	**40505**	**3.51**	**0.30**	**0.51**	**0.20**	**0.19**	**1.20**

Single Detached in RPL Land Use District

Period of Construction	Sample Size (# of Units)	Average Household Size	Average size of age cohorts per unit: Pre-school children	Elementary students	Junior High students	Senior High students	Average Number of Pre-Schoolers & Students per Unit
1990's	169	2.75	0.36	0.24	0.10	0.05	0.75
1985-1989	317	3.34	0.51	0.49	0.15	0.10	1.25
1980-1984	1332	3.26	0.44	0.54	0.16	0.10	1.24
1975-1979	199	3.33	0.29	0.43	0.22	0.21	1.15
1970-1974	0						
All Periods	**3215**	**3.23**	**0.42**	**0.50**	**0.14**	**0.11**	**1.17**

Semi-Detached in RF4 Land Use District

Period of Construction	Sample Size (# of Units)	Average Household Size	Average size of age cohorts per unit: Pre-school children	Elementary students	Junior High students	Senior High students	Average Number of Pre-Schoolers & Students per Unit
1990's	2	2.50	0.00	0.00	0.00	0.00	0.00
1985-1989	233	3.36	0.47	0.49	0.10	0.11	1.17
1980-1984	884	3.41	0.34	0.58	0.18	0.17	1.27
1975-1979	886	3.32	0.35	0.47	0.17	0.14	1.13
1970-1974	226	3.38	0.27	0.50	0.20	0.21	1.18
All Periods	**2966**	**3.26**	**0.33**	**0.49**	**0.17**	**0.15**	**1.14**

Row Housing in RF5/DC5 Land Use Districts

Period of Construction	Sample Size (# of Units)	Average Household Size	Average size of age cohorts per unit: Pre-school children	Elementary students	Junior High students	Senior High students	Average Number of Pre-Schoolers & Students per Unit
1990's	1000	2.60	0.28	0.30	0.10	0.11	0.79
1985-1989	155	1.87	0.07	0.12	0.03	0.03	0.25
1980-1984	7196	2.90	0.38	0.46	0.14	0.12	1.10
1975-1979	7572	2.86	0.34	0.43	0.14	0.12	1.03
1970-1974	1472	3.00	0.28	0.47	0.18	0.14	1.07
All Periods	**16915**	**2.87**	**0.34**	**0.44**	**0.14**	**0.12**	**1.04**

Apartments in RA7/RA8 Land Use Districts

Period of Construction	Sample Size (# of Units)	Average Household Size	Average size of age cohorts per unit: Pre-school children	Elementary students	Junior High students	Senior High students	Average Number of Pre-Schoolers & Students per Unit
1990's	0						
1985-1989	0						
1980-1984	2813	1.91	0.16	0.13	0.03	0.03	0.35
1975-1979	5343	2.09	0.21	0.17	0.05	0.05	0.48
1970-1974	511	2.40	0.26	0.22	0.09	0.09	0.66
All Periods	**12545**	**2.05**	**0.20**	**0.16**	**0.05**	**0.05**	**0.46**

3.0 Testing the Principles - The Redesign

As stated in the introduction to this report, the purpose of the review of neighbourhood design is two fold:

- to review the design of neighbourhoods to make the infrastructure more cost efficient while maintaining a good living environment, and
- to generate thought, discussion and general principles which would encourage flexibility and innovation in the design and servicing of new neighbourhoods.

In order to test the cost implications of the change to neighbourhood design introduced by the principles, three existing neighbourhoods were "redesigned" and the costs of the redesign compared to the existing. It should be noted at the outset that the "redesign" represents one application of the principles which could be adjusted to emphasize some aspects of the design over others. The principles could likewise be applied in other ways resulting with a different plan altogether. The point is, this plan is not the be all and end all of neighbourhood design but simply an illustration of the draft Principles for cost comparison purposes. It is hoped that the development industry will apply the principles in the design of new neighbourhoods to achieve cost efficiencies and further challenge the status quo.

3.1 Site Selection

The neighbourhoods of Blue Quill, Blue Quill Estates and Sweetgrass bounded by 34 Avenue to the north, 111 Street to the east, 23 Avenue to the south and Whitemud Creek ravine to the west as shown on Figure 1 were chosen to be redesigned by applying the draft Suburban Neighbourhood Design Principles[2]. These neighbourhoods were chosen for a number of reasons:

- fully developed
- ample arterial road access with varying amounts of traffic i.e. "minor" and "major" arterials
- adjacent to a ravine within the North Saskatchewan River Valley Bylaw
- ample open space with constructed and vacant school sites
- large enough population base to support certain facilities but still opportunity to intensify
- "typical" suburban land use and road layout

3.2 The Plan

It is important to realize that the plan prepared by the working committee is but one expression of the Principles. It does not explore the smallest details. It considers detailed analyses within the expertise of the participants only. For example, the projected student population and the split between the Public and Catholic School Districts was used to determine how many schools are needed. A retail demand analysis was not undertaken to determine the size of the commercial component included at the focal point of the neighbourhood. It could be bigger. What is important is the recognition that a mixture of uses central to a catchment area will provide a focus for the neighbourhoods much like that existing in the area now but more central to those who depend on it.

LOCATION OF SELECTED NEIGHBOURHOODS IN SW EDMONTON FIGURE 1

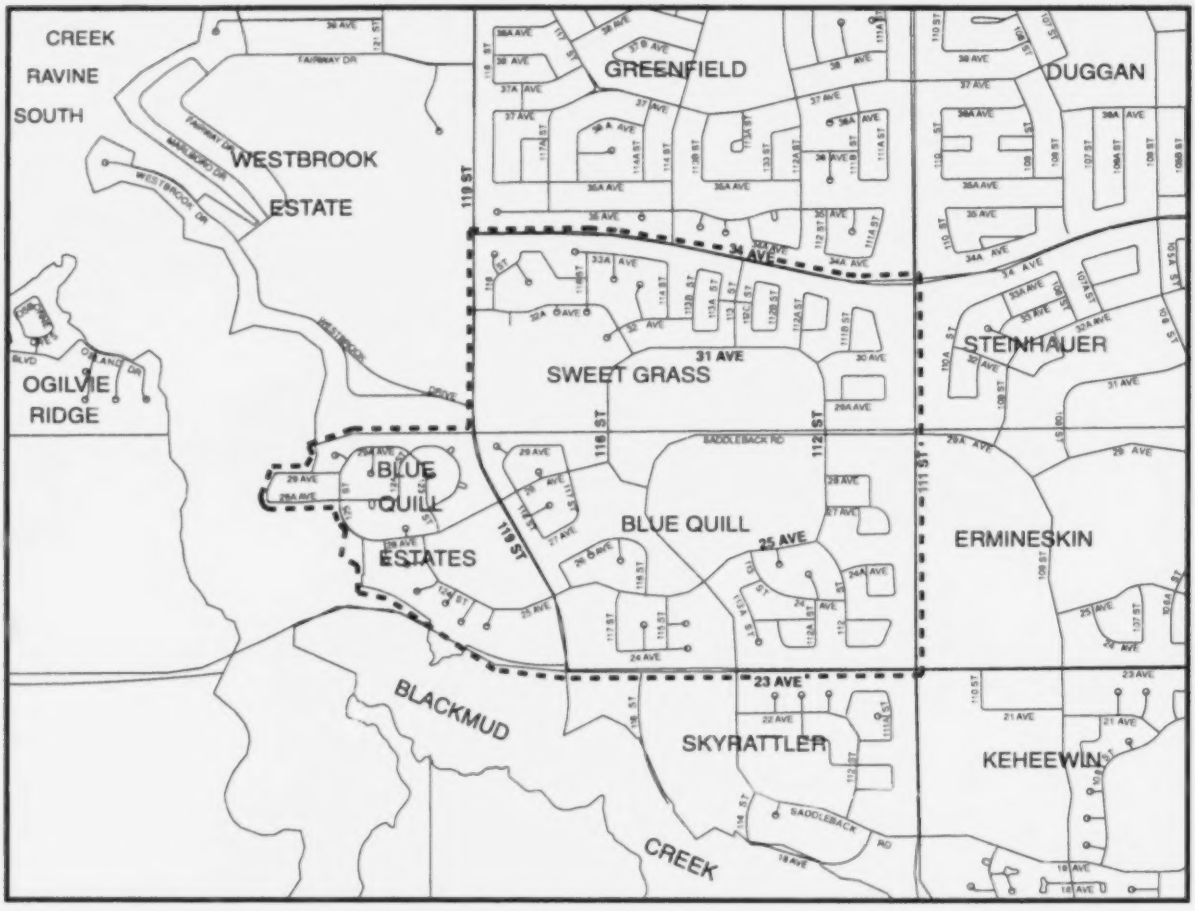


Figure 2 provides the land use plan of the neighbourhoods as they exist. Table 3 provides land use and population statistics for the existing neighbourhoods.

Figure 3 exhibits the redesigned neighbourhoods using the draft Principles developed by the working committee as outlined in the working paper. It is followed by Table 4 with the corresponding land use and population statistics.

3.3 Impacts of the "Redesign"

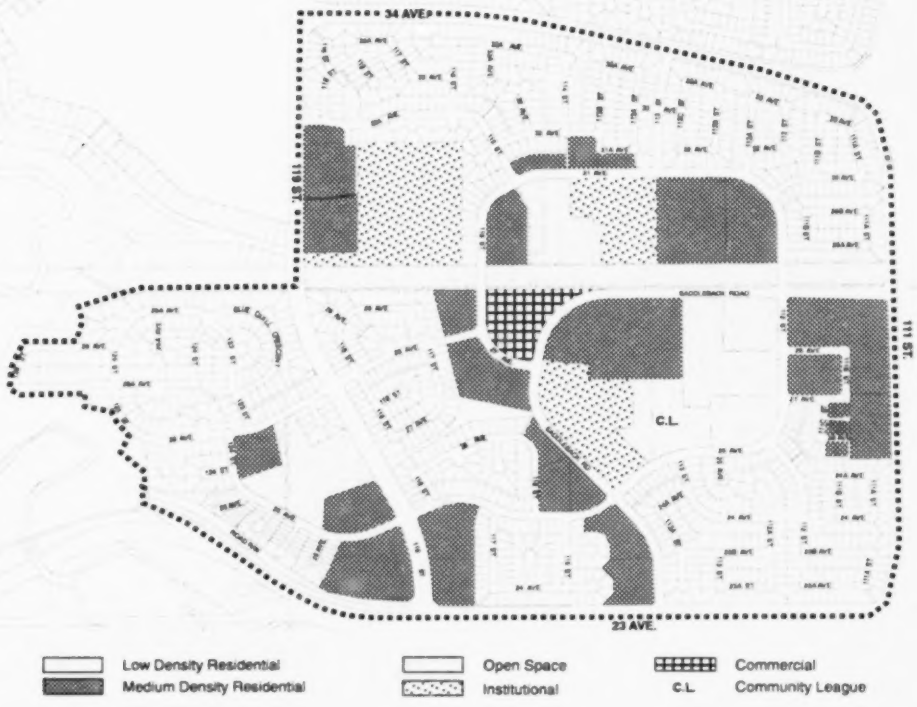
3.3.a Land Use

Following is a summary of some of the land use implications of the redesign.

- more net land is available for development (139.5 ha existing vs. 144.8 ha redesign)
- total units within neighbourhoods remain constant with 3,647 existing and 3,627 in the redesign
- single family/multi family housing mixture changes from 34/66 existing to 66/34 redesigned respecting Council's guideline of a maximum 35% multi family units within a neighbourhood
- the total population within the neighbourhoods increased from 9,603 to 11,788 due to the change in housing mixture
- concentration of public, institutional and commercial facilities creates a focal point and destination
- the major focal point is located central to the catchment area that will use and support it
- commercial on the periphery of the neighbourhood caters not only to the neighbourhoods but passer by traffic as well
- the focal point provides opportunities for concentrating community needs, sharing facilities between user groups and the reuse of facilities over time
- the focal points are enhanced through street design, placement of storm water management facilities, school and park sites
- opportunities can exist within the neighbourhood for local oriented needs (the corner store for example) and such uses as home based businesses
- the Top-of-the-Bank Roadway Policy has been respected
- opportunity for a greater variety of low density lot sizes (average of 11.0 m width)
- mixture of laned and laneless areas provides opportunity for variety in housing form and siting of buildings
- opportunity to develop different housing types or lot sizes within the given cells
- higher intensity uses like multi-family developments and the major focal point are oriented to the periphery of the neighbourhood to provide a greater population base closer to main transportation routes and transit and to reduce servicing costs
- sidewalks, boulevards and tree planting can be provided within the 17 metre rights of way
- many attractive entryways to the neighbourhood can be provided due to number and scale of accesses

EXISTING SWEET GRASS, BLUE QUILL and BLUE QUILL ESTATES

Figure 2



REDESIGNED SWEET GRASS, BLUE QUILL and BLUE QUILL ESTATES

Figure 3

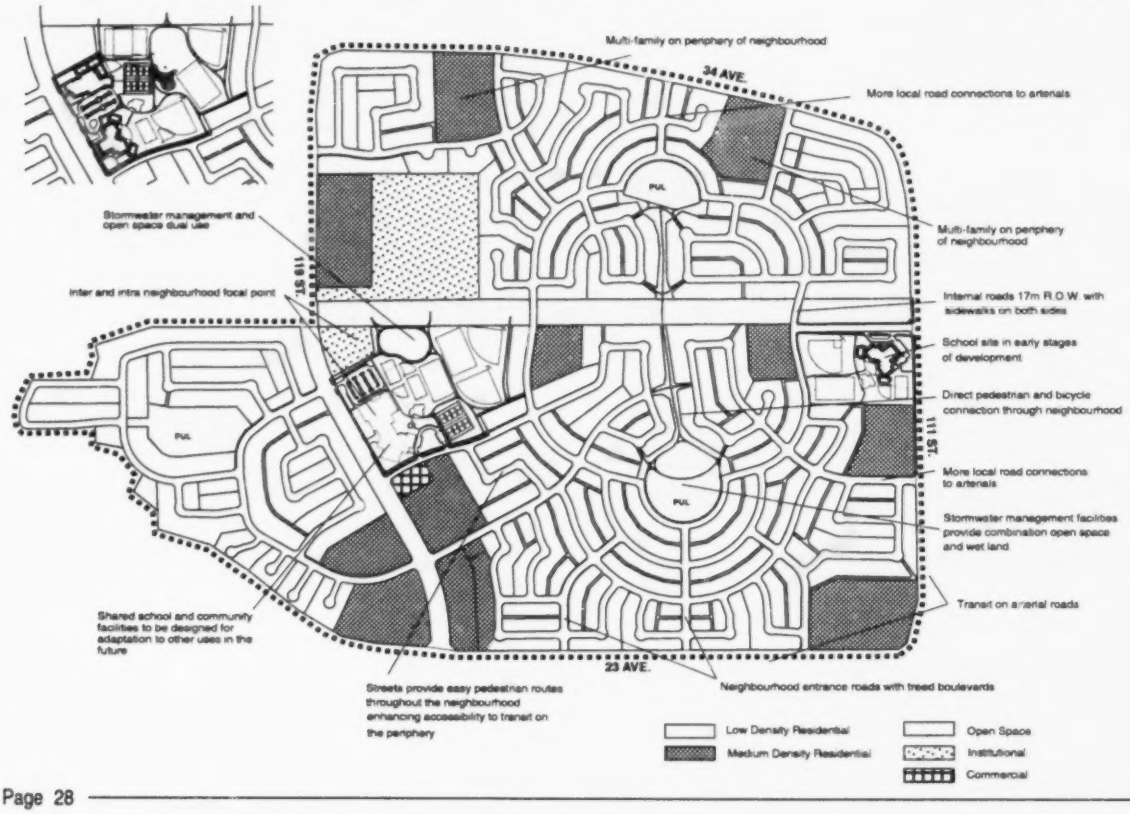

Multi-family on periphery of neighbourhood
34 AVE.
More local road connections to arterials
PUL
Stormwater management and open space dual use
Multi-family on periphery of neighbourhood
119 ST.
Inter and intra neighbourhood focal point
Internal roads 17m R.O.W. with sidewalks on both sides
School site in early stages of development
Direct pedestrian and bicycle connection through neighbourhood
111 ST.
More local road connections to arterials
Stormwater management facilities provide combination open space and wet land
Transit on arterial roads
Shared school and community facilities to be designed for adaptation to other uses in the future
23 AVE.
Streets provide easy pedestrian routes throughout the neighbourhood enhancing accessibility to transit on the periphery
Neighbourhood entrance roads with treed boulevards
Low Density Residential
Medium Density Residential
Open Space
Institutional
Commercial

Table 3

Land Use and Population Statistics for Existing Blue Quill, Blue Quill Estates and Sweetgrass Neighbourhoods

	Hectares		% of Gross Area
TransAlta r/w	8.5		
Roadways	42.5	19.5 km	19.0%
Lanes	1.4	2.2 km	0.63%
Schools/Parks	27.1		12.16%
Public Utility Lot	3.8		
Walkways			
Institutional	8.3		
Commercial	2.5		
Medium Density Residential	42.2		
Low Density Residential	86.5		
TOTAL AREA	**222.8 ha**		

Low Density Lot Width Range = 16.8 to 22 m
Average Low Density Lot Area = 704 m.sq.
Low Density Frontage = 22,678 m
Medium Density Frontage = 7,403 m

Population Statistics (Based on Full Occupancy)

	Area (ha)	Total Units	Population
Low Density	86.5	1228	4280 persons
Medium Density	42.2	2419	5323 persons
	128.7	3647	9603 persons

34% Single Family, 66% Multiple Family

16.4 units per gross developable ha
43.1 persons per gross developable ha

Table 4

Land Use and Population Statistics for Redesigned
Blue Quill, Blue Quill Estates and Sweetgrass Neighbourhoods

	Hectares		% of Gross Area
TransAlta r/w	8.5		
Roadways	40.0	21.2 km	17.9%
Lanes	5.0	8.2 km	2.24%
Schools/Parks	15.4		6.9%
Public Utility Lot Walkways	9.1		
Institutional	9.4		
Commercial	0.5		
Medium Density Residential	29.7		
Low Density Residential	105.2		
TOTAL AREA	**222.8 ha**		

Average Low Density Lot Width = 11 m
Average Low Density Lot Area = 400 m.sq.
Low Density Frontage = 26,258 m
Medium Density Frontage = 5,012 m

Population Statistics

	Area (ha)	Total Units	Population
Low Density	105.2	2386	8375 persons
Medium Density	29.7	1241	3424 persons
	134.9	3627	11,788 persons

66% Single Family, 34% Multiple Family

16.3 units per gross developable ha
53.9 persons per gross developable ha

3.3.b Transportation

The redesign results in a number of Transportation related impacts including:

- no "collector" standard roadways within the neighbourhoods
- all local roads are assumed to be 9 m pavement on a 17 m right-of-way
- more local road access to surrounding arterials
- ample flexibility for access/egress
- no barrier to neighbourhood cohesiveness created by non- residential streets
- all local roads are used as residential streets
- streets are more pedestrian friendly
- less non school oriented traffic past school sites will reduce congestion at school drop off/pick up times
- designing streets for their intended purpose means the street in front of the school can more effectively deal with localized school traffic conditions

Transportation related cost estimates comparing the existing neighbourhood to the redesign have been prepared as shown on Table 5. For the existing neighbourhood, the cost estimate used the existing circulation patterns but included additional capital costs not required at the time of the neighbourhoods original development but which would be required today. For example, a concrete bikeway on the arterial was not required at the time these neighbourhoods were developed but is now included in new neighbourhood development. Including such costs ensures consistency in the comparison. All costs are in 1995 dollars for direct comparison purposes.

Estimates include all roads, sidewalks, walkways within walkway lots and the Trans Alta ROW, street lighting, walkway lighting, bikeways, and screen fencing. Estimates are based on plans at a scale of 1:3000 and therefore are considered rough planning level estimates. They are based on simple construction unit rates.

Transportation infrastructure in the existing neighbourhoods is estimated to cost $21,874,000. The redesign plan is estimated to cost $21,910,000. On a per residential unit basis, costs would be $5,997/unit for the existing neighbourhood and $6040/ unit for the redesign plan.

Table 5

Transportation Cost Estimates for Existing and Redesigned Neighbourhoods

EXISTING

ITEM	*QUANTITY lin m*	*UNIT RATE $/m*	*COST*
15.9m collector/bus	1380	910.00	$1,256,000
15.9 to 23m transition	240	1100.00	$264,000
14.5m collector/bus	280	790.00	$221,000
11.5m collector/bus	5540	687.00	$3,806,000
11.5m local	1000	615.00	$615,000
9.0m local	11080	529.00	$5,861,000
streetlighting (one side)	19280	50.00	$964,000
residential lane	2220	111.68	$248,000
1.5m concrete walkway (w-lot)	1680	47.27	$79,000
2.5m asphalt walkway/bikeway (Pipeline ROW)	1370	38.20	$52,000
walkway lighting	3050	45.00	$137,000
2.5m concrete bikeway (arterial)	1050	78.78	$83,000
1.8m solid screen fence	2450	45.00	$110,000
1.8m screen fence	3210	35.00	$112,000
1.2m screen fence	6360	30.00	$191,000
	TOTAL		$13,999,000
	DESIGN & CONSTR.	25%	$3,500,000
	CONTINGENCIES	25%	$4,375,000
	TOTAL COST		**$21,874,000**

REDESIGNED

ITEM	*QUANTITY lin m*	*UNIT RATE $/m*	*COST*
11.5m local roadway	780	615.00	$480,000
11.5m to 9m (blvd) transition	845	589.00	$498,000
9m (blvd) local roadway	2640	563.00	$1,486,000
9m (mono) local roadway	16920	529.00	$8,951,000
streetlighting (one side)	21185	50.00	$1,059,000
residential lane	8160	111.68	$911,000
1.5m concrete walkway (w-lot)	430	47.27	$20,000
2.5m asphalt walkway/bikeway (Pipeline ROW)	1370	38.20	$52,000
walkway lighting	1800	45.00	$81,000
2.5m concrete bikeway (arterial)	1040	78.78	$82,000
1.8m solid screen fence	2250	45.00	$101,000
1.8m screen fence	2970	35.00	$104,000
1.2m screen fence	6570	30.00	$197,000
	TOTAL		$14,022,000
	DESIGN & CONSTR.	25%	$3,506,000
	CONTINGENCIES	25%	$4,382,000
	TOTAL COST		**$21,910,000**

3.3.c Transit

Removal of transit routes from the interior of the neighbourhoods has limited direct capital cost savings. The required number of transit stops would be reduced from 59 to 32 in the redesign. The capital cost savings from this would be $15,954. The savings would increase if there were several adjacent neighbourhoods sharing the same transit zones along the arterial roadway (i.e. if the neighbourhoods north of 34 Avenue and east of 111 Street also included peripheral bus service).

There is an indirect capital cost saving as well in that no interior roads need be designed or constructed to accommodate bus traffic. This, combined with the redistribution of other neighbourhood traffic by providing more access points to surrounding arterial roads, means there is no longer a need for a bus route constructed with an 11.5 m carriageway on a 20 m right-of-way. All roads can be 9 m carriageway on a 17 m right-of-way. The unit rate per metre of roadway (not including walks and lighting) decreases from $687 to $529. This may mean savings in land and capital construction which have already been included in the costs described in Section 3.3.b.

There may be additional costs with the redesign to provide pedestrian activated traffic signals because of the need for transit users to cross arterial roadways to access the transit system. Cost of such signals varies between $20,000 and $40,000 each. Depending on the number of signals required, this may impact the flow of traffic on arterials.

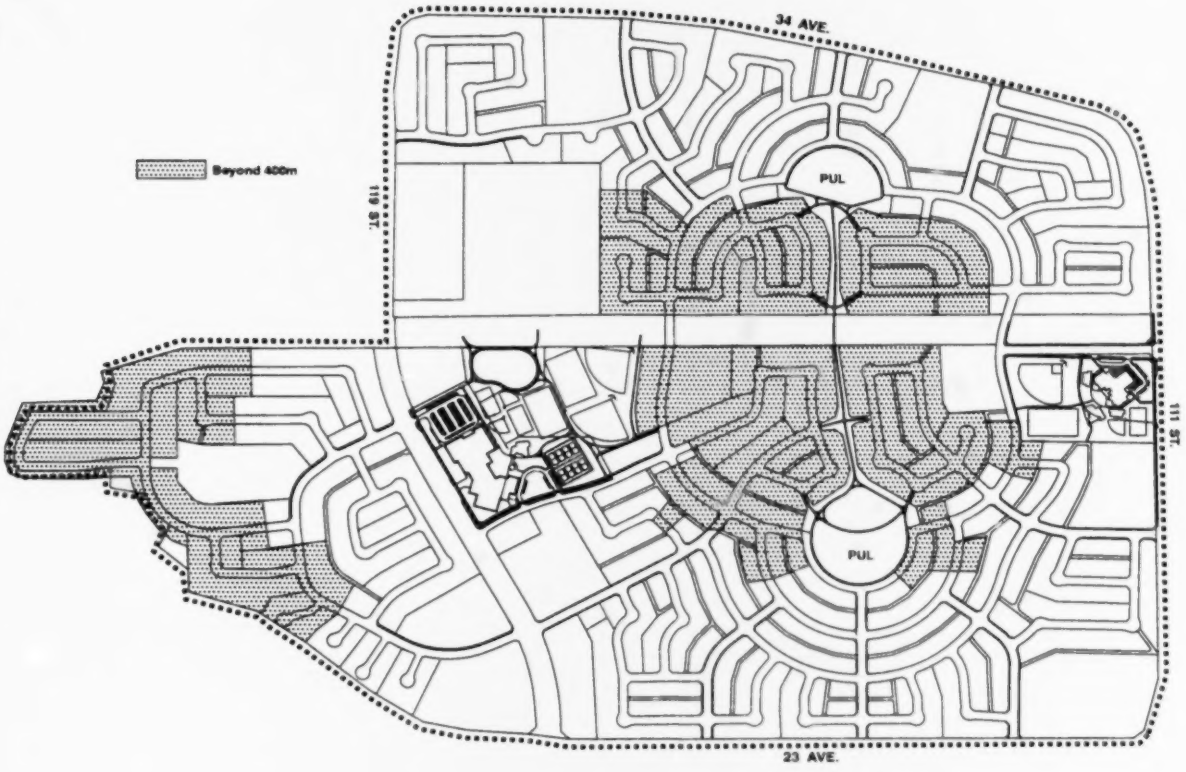
The removal of transit routes from the interior of the neighbourhood would reduce the travel time required for each route serving the neighbourhood. The savings from a single neighbourhood would not result in operating cost savings because the same number of buses would be required to serve the neighbourhood. However, operating cost savings would be achieved when a number of adjacent neighbourhoods are developed using peripheral transit service as shown in the revised neighbourhood design. Each route could then serve the two neighbourhoods on either side of the arterial roadway.

Theoretically, under the existing neighbourhood design, two adjacent neighbourhoods with a total width of two miles would have four routes serving their interiors. The redesign would have three routes serving them along the arterial roadways. Assuming that these neighbourhoods are fully developed and are served by Transit in all time periods, the operational savings would be approximately $225,000 per year ($112,500 for each neighbourhood). This assumes that the same number of buses would be required during the peak periods so that sufficient capacity is provided. That is, savings would be derived during off-peak periods.

The redesign does have impacts on Transit's ability to meet the current transit service standard of providing service within 400 m of residences. Approximately 33% of the Low Density units and 4% of the Medium Density units are not within the standard 400 metre walking distance. Figure 4 illustrates those areas which lie beyond 400 m. This is largely due to the presence of the creek and golf course to

REDESIGNED SWEET GRASS, BLUE QUILL and BLUE QUILL ESTATES
TRANSIT WALKING DISTANCE

Figure 4



the west and north respectively of Blue Quill Estates and the inability to provide grid based arterial or collector roads along the west edge of the neighbourhood. Given that most multi-family residences are located adjacent to a transit route in the redesigned plan, 76% of all residents (or approximately 8960 people) are located within 400 m of a transit zone. This is comparable to the total population which presently exists in the three neighbourhoods (9603 people).

In conclusion, assuming no alternate transit service is provided to the interior of the neighbourhood, the redesign results in operational cost savings which would be even greater if applied to a larger segment of the City. While it is difficult to illustrate when dealing with a small area such as the three neighbourhoods, the idea behind this change to transit service is in keeping with current Transit planning theory. In current theory, a "core system" is provided which serves the most basic needs of captive transit riders. This is supplemented by tiers of service, which may vary among parts of the City, to provide enhanced service where needed. The Neighbourhood Design Principles support the provision of a "core system".

If small bus service is needed, Edmonton Transit's current fleet mix could not provide small buses for developing neighbourhoods. Based on current growth projections and the time required for a developing neighbourhood to warrant transit service, there is time to adjust the five year capital program to achieve the appropriate mix.

3.3.d Parks and Schools and Stormwater Management Facilities

The design principles applied in the redesign result in the following impacts:

- reduce land requirements over conventional neighbourhoods due to sharing of parking, play fields, buildings
- reduce land requirements over conventional neighbourhoods due to dual use opportunities with adjacent storm water management facility
- concerns relative to safety and liability, health, supervision and maintenance within dual use areas need to be explored
- reduce capital construction due to sharing of parking, play fields, buildings, storm water management
- the open space component is distributed and connected throughout the neighbourhood through use of municipal reserve lands, power right of way, storm water management facilities and the local sidewalk/street system
- school drop off activity is not on local streets
- transit service and bus drop off activities for schools can take place from peripheral arterial roads
- enhanced pedestrian and bicycle linkages will provide improved access to schools, which may encourage more students to walk, reducing bussing and/or parent drop-off activity
- schools are more central to the catchment areas they serve, making them more accessible for students from the broader geographic area
- may need more pedestrian crosswalks of arterials, especially in the area of the schools
- storm water management facilities provide an amenity to the neighbourhood
- storm water management facilities aid in achieving better quality of effluent.

The existing neighbourhoods do not include any stormwater management facilities (SWMF). All stormwater feeds into under street piping and is directed to a deep storm sewer located within the Trans Alta Utilities right-of-way. The redesign includes three 2.5 hectare SWMF and one dual use site. The dual use site consists of a 1.4 ha public utility lot with 3 ha of municipal reserve within the westerly school/park site. The 3 ha MR is designed to flood during major storm events. Due to the fact that there are no SWMF in the existing neighbourhoods, it is difficult to do a comparison of the existing piped system with the SWMF system. However, it is desirable to do a cost comparison of the dual use opportunity to help determine if it is worth pursuing.

As well, the existing neighbourhood exceeds current standards for the provision of parkland and far exceeds the proposals of the redesign. Comparing the existing neighbourhood municipal reserve considerations to the redesign would not be representative of todays standards and the redesign.

Therefore, for cost comparison purposes, three scenarios have been generated including:

Scenario A Costs to assemble and develop park and school lands as they exist today

City costs to assemble and develop	$2,441,152	
Proportionate District Park Costs	$1,040,000	
Total Developer Contribution	$0	
Total Cost	$3,480,000	
Total Developer Land Dedication	22.28 ha	100 % is MR

Scenario A includes 27.082 ha of MR land with no land or development costs for SWMF and no cash-in-lieu.

Scenario B Costs to assemble and develop park, school and stormwater management lands if they were planned within the existing neighbourhood design but using 1995 park standards

City Costs above 10 % MR	$ 872,416	
Proportionate District Park Costs	$1,040,000	
Total Developer Contribution	$3,900,000	
Total Cost	$5,812,000	
Total Developer Land Dedication	28.2 ha	65 % is MR 35 % is PUL

Scenario B includes 18.2 ha of MR land; $504,084 cash-in-lieu (representing 4.08 ha of land); 10 ha for SWMF; and, SWMF development costs of $3,900,000.

Scenario C Costs to assemble and develop park, school and stormwater management lands as proposed by the redesign

City Costs above 10% MR	$ 357,536	
Proportionate District Park Costs	$1,040,000	
Total Developer Contribution	$3,568,500	
Total Cost	$4,968,500	
Total Developer Land Dedication	24.31 ha	63 % is MR 37 % is PUL

Scenario C includes 15.41 ha of MR land; $848,789 cash-in-lieu (representing 6.87 ha of land); 8.9 ha for SWMF; and, SWMF development costs of $3,568,500.

Comparing Scenarios A and C, Scenario C (the redesign) has 11.67 ha less MR and 8.9 ha more PUL's for SWMF.

The more relevant comparison is between Scenarios B and C (the redesign) since B represents the application of today's standards. There is 2.79 ha less MR land in C; there is $344,700 more cash-in-lieu (representing 2.79 ha of land) in C; there is 1.1 ha less PUL's for SWMF in C and the developers cost to develop the PUL's and dual use site is $331,500 less in C than developing the PUL's in B.

In summary, both scenarios B and C assume a full 10 % MR dedication. Scenario C takes more of this in cash which assists the City in being able to develop the parkland with $514,875 less impact on the tax levy. The developer pays MR cash-in-lieu at raw land values and is left with 3.89 ha (2.79 ha from MR land savings and 1.1 ha from reduced PUL requirements) more developable land which can bring a higher return than that paid to the City. The developers cost to construct SWMF is reduced by $331,500 including the 3.0 ha of MR which would be used as dual use lands.

Tables 6, 7 and 8 exhibit details of the three scenarios. The three scenarios include not only the neighbourhood facilities but the neighbourhoods proportionate share of assembly and development of a district campus.

Table 6

SCENARIO A **COSTS TO ASSEMBLE AND DEVELOP PARK AND SCHOOL LANDS AS THEY EXIST TODAY**

NOTE: - Does not consider surplus school site impacts.
- Assumes school and park sites are fully developed.

CITY COSTS

1.	Combined GDA of 3 existing neighbourhoods	222.8 ha	
2.	10% MR combined entitlement	22.28 ha	
3.	Existing combined population	9,600	
4.	No. neighbourhood catchment areas	3	
5.	Actual land assembled:		
	Sweet Grass	7.061 ha	
	Blue Quill	15.590 ha	
	Blue Quill West	4.431 ha	
		27.082 ha	
6.	Parks and school MR impact		-4.802ha
7.	Existing stormwater management facilities (SWMF)		NIL
8.	Land assembly and development		
a.	Land assembly		100%MR
b.	Excess land assembly 4.802 x $123,550 / ha = $593,287		$593,287
c.	GLS @ $3.25/m² x 270,820 m²		$877,865
d.	Sports fixtures assume capital allowance		$45,000
e.	Tree planting assume capital allowance 2 x $150,000 + 1 x $50,000		$350,000
f.	Environmental preservation		N/A
g.	Mechanical drainage assume capital allowance 2 x $75,000		$150,000
h.	Neighbourhood park sign 3 x $5,000		$15,000
i.	NPDP City contribution for cost-sharing 3 x $60,000		$180,000
j.	One time community league installation 3 x $60,000		$180,000
k.	Walks and security lighting assume capital allowance 2 x $20,000 + 1 x $10,000		$50,000

Total City costs to assemble and develop neighbourhood school and park land including land in excess of 10% MR entitlement **$2,441,152**

Total City cost to assemble and develop proportionate amount of District Campus Site as follows:

Assume 24.3 ha @ $123,550/ha land assembly	$3,000,000
Assume 16.2 ha @ $61,775/ha base level development	$1,000,000
Assume 8.1 ha @ $19,770/ha basic grade level seed	$160,000

Assume average Campus serves population of 40,000 then proportionately this area would be assessed for this exercise only, 25% of these costs
$3.0 +$1.0 + $.16 = $ 4.16
$ 4.16 x .25 = $ 1,040,000 **$1,040,000**

Total City projected costs to assemble and develop Neighbourhood and proportionate District level School and Park Lands including land in excess of 10% MR entitlement
$2.44+ $ 1.04 = $ 3.48 **$3,480,000**

TOTAL DEVELOPER CONTRIBUTION **$0**

Note at the time these Neighbourhoods were developed, Storm Water Management facilities were not a requirement.

Costs for oversized pipes and downstream charges cannot be calculated and therefore do not clearly reflect the actual costs to provide storm drainage facilities.

TOTAL COSTS in addition to MR **$3,480,000**
(excluding schools and major recreational facilities)

Table 7

SCENARIO B **COST TO ASSEMBLE AND DEVELOP PARK, SCHOOL AND STORMWATER MANAGEMENT LANDS IF THEY WERE PLANNED IN 1995 USING CURRENT STANDARDS**

NOTE: - Does not consider surplus school site impacts.
- Assumes school and park sites are fully developed.

CITY COSTS

1.	Combined GDA of 3 existing neighbourhoods			222.8 ha
2.	10% MR combined entitlement			22.28 ha
3.	Assumed population same			9,600
4.	No. of neighbourhood catchment areas			2
5.	Assumed land assembly			
	Catchment Area 1			
	1.	EPSB K-8 (Bldg. & Fields)	4.45 ha	
	2.	ECSB K-9 (Bldg. & Fields)	4.04 ha	
	3.	Community league and Park	2.63 ha	
			11.12 ha	
	Catchment Area 2			
	1.	EPSB K-8 (Bldg. & Fields)	4.45 ha	
	2.	Community league and Park	2.63 ha	
			7.08 ha	
		TOTAL:	18.20 ha	
6.	School and park MR impact 22.28 ha - 18.2 ha = 4.08 ha x $123,550 / ha = **$504,084 Cash in Lieu**			+4.08ha
7.	Assumed Stormwater Management Facilities			10 ha
8.	Land assembly and development			
	a.	Land assembly		81.7% MR
	b.	Excess land assembly		$0
	c.	GLS @ $3.25/m² x 182,000 m²		$591,500
	d.	Sports fixtures assume capital allowance		$45,000
	e.	Tree planting assume capital allowance 2 x $150,000		$300,000
	f.	Environmental preservation		N/A
	g.	Mechanical drainage assume capital allowance 2 x $75,000		$150,000
	h.	Neighbourhood park sign 2 x $5,000		$10,000
	i.	NPDP City contribution for cost-sharing 2 x $60,000		$120,000
	j.	One time community league installation 2 x $60,000		$120,000
	k.	Walks/security lighting assume capital allowance 2 x $20,000		$40,000
		Land Assembly and Development Costs =		$1,376,500

Total City costs to assemble and develop Neighbourhood School and Park land in excess of 10 % MR land and cash
$1,376,500 - $504,084 = $872,416 **$872,416**

Total City cost to assemble and develop proportionate amount of District Campus Site as follows:

Assume 24.3 ha @ $123,550/ha land assembly $3,000,000
Assume 16.2 ha @ $61,775/ha base level development $1,000,000
Assume 8.1 ha @ $19,770/ha basic grade level seed $160,000
Assume average Campus serves population of 40,000 then
proportionately this area would be assessed for this exercise only, 25% of these costs
$3.0 +$1.0 + $.16 = $ 4.16
$ 4.16 x .25 = $ 1,040,000 **$1,040,000**

Total City projected costs to assemble and develop Neighbourhood and proportionate District level School and Park Lands in excess of 10% MR entitlement
$ 872 + $ 1,040 = $ 2,145 **$1,912,000**

TOTAL DEVELOPER CONTRIBUTION

4 Stormwater Management Facilities
Assume average land requirements 2.5 ha each facility
Average capital cost allowance $390,000 / ha x 2.5 ha = $975,000
Excavate and remove soils
Rough grade, grade, level, seed
Landscape
Amenities and fixtures
Drainage structures
4 Facilities x $975,000 **$3,900,000**

TOTAL COSTS in addition to MR (excluding schools and major recreational facilities) **$5,812,000**

TABLE 8

SCENARIO C **COST TO ASSEMBLE AND DEVELOP PARK, SCHOOL AND STORMWATER MANAGEMENT LANDS AS PROPOSED IN THE REDESIGN NEIGHBOURHOOD**

NOTE: - Does not consider surplus school site impacts.
- Assumes school and park sites are fully developed.

CITY COSTS

1.	Combined GDA of 3 existing neighbourhoods		222.8 ha
2.	10% MR combined entitlement		22.28 ha
3.	Assumed population same		12,568
4.	No. of neighbourhood catchment areas		2
5.	Assumed land assembly		
	Catchment Area 1		
	1. EPSB K-8 (Bldg. & Fields)	1.52 ha	
	2. ECSB K-9 (Bldg. Envelope)	1.14 ha	
	3. Sports fields	4.55 ha	
	4. Community league and Park	1.86 ha	
	5. PUL (1.40 ha)	n/a	
	6. Portion MR as dual use(3.00 ha)	n/a	
		9.07 ha	
	Catchment area 2		
	1. EPSB K-8 (Bldg. Envelope)	1.58 ha	
	2. Sports fields	2.76 ha	
		4.34 ha	
	Neighbourhood top-of-bank Park with Community league	2.00 ha	
	TOTAL:	15.41ha	
16.81ha			
6.	School and park MR impact: 22.28- 15.41 = +6.87 ha 6.87 ha x $123,550 / ha = **$848,789 Cash in Lieu**		
7.	Assumed Stormwater Management Facilities 2.5+2.5+2.5+1.4 = 8.9 ha		8.9 ha
8.	Land assembly and development		
	a. Land assembly $69.2%MR		
	b. Excess land assembly		$0
	c. GLS @ $3.25/m² x 168,100 m²		$546,325
	d. Sports fixtures assume capital allowance		$45,000
	e. Tree planting assume capital allowance 2 x $150,000 + 1 x $50,000		$350,000
	f. Environmental preservation		N/A
	g. Mechanical drainage assume capital allowance 1 x $20,000		$20,000
	h. Neighbourhood park sign 3 x $5,000		$15,000
	i. NPDP City contribution for cost-sharing 2 x $60,000		$120,000
	j. One time community league installation 1 x $60,000		$60,000
	k. Walks/security lighting assume capital allowance 2 x $20,000 + 1 x $10,000		$50,000
	Land Assembly and Development Costs =		$1,206,325

Total City costs to assemble and develop land neighbourhood school and park land in excess of 10% MR land and cash entitlement
$1,206,325 - $ 848,789 cash-in-lieu = $357,536 **$357,536**

Total City cost to assemble and develop proportionate amount of
District Campus Site as follows:

Assume 24.7 ha @ $123,550/ha land assembly $3,000,000
Assume 16.2 ha @ $61,775/ha base level development $1,000,000
Assume 8.1 ha @ $19,770/ha basic grade level seed $160,000
Assume average Campus serves population of 40,000 then
proportionately this area would be assessed for this exercise only, 25% of these costs
$3.0 +$1.0 + $.16 = $ 4.16
$ 4.16 x .25 = $ 1,040,000 **$1,040,000**

Total City projected costs to assemble and develop Neighbourhood and proportionate District level School and Park Lands in excess of 10% MR entitlement
$.36 + $ 1.04 = $ 1.40 **$1,400,000**

TOTAL DEVELOPER CONTRIBUTION
3 Stormwater Management Facilities
1 Dual Use Facility
Assume average land requirements 2.5 ha each facility
Average capital cost allowance $390,000 / ha x 2.5 ha = $975,000
Excavate and remove soils
Rough grade, grade, level, seed
Landscape
Amenities and fixtures
Drainage structures
3 Facilities x $975,000 = $2,925,000 $2,925,000

1 Dual Uses Facility PUL 1.4 ha x $390,000 = $546,000
MR 3.0 ha @ $ 3.25 /m $97,000
$3,568,500

TOTAL COSTS in addition to MR (excluding schools and major recreational facilities) **$4,968,500**

3.3.e Water

The water distribution system for the redesigned neighbourhood can be extended from the water transmission mains surrounding the neighbourhood. In the case of a new neighbourhood this might not be the case and the developer or the City may be required to extend transmission mains to the edge of the neighbourhood. Therefore the water distribution cost comparison in this study only compares costs within the neighbourhood.

A water analysis was carried out for the redesign and verified by the Stoner Model. The pipes in the proposed system are generally smaller in size in the redesign, 300 mm in the existing versus 250 mm in the redesign. Locating the school sites and multiple family sites close to the edges of the neighbourhood and therefore closer to transmission mains has played a part in the reduced size of mains. However, the redesign system is longer in total length of pipe than the existing, 22.5 km vs. 19.2 km.

Using 1995 unit costs and dollars for the comparison, the overall capital cost of the existing system is estimated to be $2,426,214. The overall capital cost of the redesign system is estimated to be $2,688,820. On a per residential unit basis, the existing is $665/unit and the redesign is $741/unit. Cost summaries of the existing and redesign water systems are included in Table 9.

3.3.f Sanitary Sewers

A detailed drainage network analysis was not carried out for the redesign. However, a comparison of the length of the system was considered. The existing system is 20,721.6 m in length while the redesign is 23,442.6 m. This results in 5.68 metres/unit for the existing and 6.46 metres/unit for the redesign.

Without providing a detailed analysis of the sanitary sewer, it is very difficult to establish a cost since depth and size of pipe are major determining factors in the cost of a system.

3.3.g Storm Sewers

A detailed network analysis for storm sewers was also not carried out for the redesign. Since the existing system does not employ SWM and the redesign does, the cost comparison of one system type to the other was not considered relevant in testing the Principles. Rather the analysis relevant with respect to storm service was the introduction of dual use versus completely separate Parks and SWM facilities. The analysis is discussed in Section 3.3.d.

Table 9

Water Cost Estimates for Existing and Redesigned Neighbourhoods

Existing Water System

Diameter mm	Total Length m	Cost per m	Total Cost
150	1,990	$115.71	$230,263
200	8,240	$117.28	$966,387
250	3,780	$124.60	$470,988
300	5,210	$145.60	$758,576
Total length	**19,220**	Total	**$2,426,214**

Cost per unit:

$2,426,214 / 3647 = $665 per unit

Redesigned Water System

Diameter mm	Total Length m	Cost per m	Total Cost
150	1,794	$115.71	$207,584
200	14,125	$117.28	$1,656,580
250	6,456	$124.60	$804,418
300	139	$145.60	$20,238
Total length	**22,514**	Total	**$2,688,820**

Cost per unit:

$2,688,820 / 3627 = $741 per unit

Source: Water Branch, Public Works Department

3.3.h Summary of Differences between the Existing and Redesign Plans

Transportation

The existing plan includes 19.5 km of roads and 2.2 km of lanes using 43.9 ha of land as compared to the redesign which includes 21.2 km of roads and 8.2 km of lanes using 45 ha of land.

All transportation related costs (excluding direct transit costs) for the two plans are:

	Existing Plan	Redesign Plan
Total Cost	$21,874,000	$21,910,000
Cost per residential unit	$5,997	$6,040

Transit

	Cost Saving	Additional Cost
Transit stops	$15,954 (capital)	
Pedestrian signals		$20,000 to $40,000 each (capital)
Operational Savings	$225,000 per year*	

*assuming no alternate service into neighbourhood is provided

Parks, Schools and Stormwater Management (SWMF)

For comparison purposes, the redesign plan is compared to the existing assuming today's standards had been applied. (The existing plan contains well over 10% MR and no SWMF. Comparison to it would be meaningless.)

	Today's standards	Redesign Plan
SWMF land	10 ha	8.9 ha
MR land	18.2 ha	15.41 ha
MR cash-in-lieu	$504,084	$848,789
City costs in excess of MR land and cash	$872,416	$357,536
District Campus contribution	$1,040,000	$1,040,000
Total City Cost in excess of MR land and cash	$1,912,000	$1,400,000
Developer cost for SWMF including dual use	$3,900,000	$3,568,500

With the redesign plan, this means the developer pays $345,000 more cash-in-lieu; $331,500 less to develop SWMF; and, has 3.89 ha more land available for other purposes. It means the City needs $515,000 less from the tax levy to meet the municipal reserve and district campus needs.

Water

	Existing	Redesign
length of pipe	19.2 km	22.5 km
total cost	$2,426,214	$2,688,820
cost per residential unit	$665	$741

Sanitary Sewer

	Existing	Redesign
length of pipe	20721.6 m	23,442.6 m
pipe per residential unit	5.68 m	6.46 m

3.3.i Front Foot Costs of Development

At the request of UDI and with assistance from consultant members, the estimated cost of the redesign plan was also assessed considering costs of development per front foot. Some of the construction costs, i.e. for storm and sanitary laterals, were extrapolated from the length of pipe determined through the water network analysis. This sort of extrapolation was not done in the Administration generated unit costs. Table 10 illustrates a summary of the construction costs and "other costs" but does not include arterial roads; land, legal fees and commissions; financing charges and all taxes; maintenance and clean up costs; promotion and advertising costs; architectural controls; bonding and insurance.

Based on these assumptions, front foot cost would be $374 for construction costs escalated to $598 when consulting fees, assessments, cash-in-lieu, etc. (Table 10) are included. This does not include other items as noted in the preceding paragraph.

3.3.j Conclusions

The redesign developed from the Suburban Neighbourhood Design Principles show that the infrastructure costs are similar between the redesign and the actual neighbourhood design. However, the redesign yields 5.3 ha more net developable land than the existing.

The redesign suggests major changes with respect to municipal reserves. These changes include the amount of municipal reserve taken as land and the amount taken as cash-in-lieu of land; the location of school/park sites; the sharing of buildings, parking, and play fields among users of the school/park sites and adjacent uses; and, dual use of land for parks and storm water management facilities.

It recognizes that, with a change in the type of stormwater management facility built on PUL's (dispersed and a combination of dry and wet areas), these areas can provide additional open space amenities to more residents of a neighbourhood.

The redesign provides a substantial change to the road network within the neighbourhoods by providing much more access to arterial roads surrounding the neighbourhoods; by not providing an internal collector standard roadway; by including areas with and without lanes; by including sidewalks on both sides of all streets; and, by including more direct routes throughout the neighbourhoods using a combination of streets; open spaces and walkways. The redesign assumes all internal roadways to be constructed using a 9 metre road on a 17 metre right-of-way. Further savings in road right-of-way and construction may be possible based on a more detailed analysis of each road. The redesign makes ample use of lanes which has implications from a cost perspective as well as the standard of front streets needed. This should be further reviewed.

These changes to the road system require and facilitate change to the delivery of transit service from a neighbourhood oriented service to a core service approach provided on the arterial roadways.

From a land use perspective, the redesign takes a different approach in incorporating a multi use focal point central to the catchment area for schools, community leagues and commercial activity. It orients multi family development to the focal point and exterior portions of the neighbourhood to support the arterial bus service. It reverses the single family/multi family split of housing units from 34/66 to 66/34, in keeping with Council's guideline. Because single family units normally house more people per unit than multi family units, this means the projected population of the redesign would be higher than the existing while the number of total housing units remains fairly constant. A review of siting requirements for single family development might reveal opportunity for intensification of single family. As well, a further review of the single family/multi family split might be in order to determine if the percentages should change.

The areas of least change exhibited by the redesign are those areas affecting underground infrastructure. With the exception of introducing stormwater management and dual use through the redesign, little was done to review the methods of service provision or the service standards as they relate to water, sanitary sewers or storm sewers. This must be undertaken and must be coordinated with the further review of internal street standards.

Table 10

Costs per Front Foot

Gross Developable Area	222.8 ha	
Single Family Frontage	86,125 ft	26,258 m
Multi-Family Frontage	16,440 ft	5,012 m
Total Frontage	102,565 ft	31,270 m
No. of Single Family Lots	2386	
No. of Multi-Family Units	1241	
Total Units	3627	

CONSTRUCTION COSTS	Cost Estimate $	Cost per front foot $	Notes
Rough Grading	$3,221,000	$31	Based on $1350/lot
Storm Sewer	$5,378,000	$52	Based on ratio of Water costs provided-includes SWMF costs
Sanitary Sewer	$3,764,000	$37	Based on ratio of Water costs provided
Watermain	$2,689,000	$26	Provided by Water Branch
Road Construction	$13,539,000	$132	Provided by Transportation Dept.
Power	$4,818,000	$47	Includes walkway lights
Landscaping	$1,118,000	$11	Based on $300/lot
Lot Servicing	$3,870,000	$38	Based on $1800/lot
Total Construction Costs	$38,397,000	$374	

OTHER COSTS	Cost Estimate $	Cost per front foot $	Notes
Consulting Fees	$5,583,000	$54	Based on $500/lot and 10% of construction costs
Testing	$1,728,000	$17	Based on 4.5% of construction costs
Development Fees	$881,000	$9	
Assessments	$10,175,000	$99	Based on industry constants
Cash-in-Lieu	$849,000	$8	Money paid in lieu of providing park land (See Table 8)
Contingency/Maintenance	$3,840,000	$37	Based on 10% of Construction costs
Total Other Costs	$23,056,000	$224	
TOTAL COSTS	$61, 453,000	$598	

4.0 FURTHER ACTIONS

The redesign examined by the working committee and summarized in Section 3 of this report served to test the January 1995 draft principles in accordance with the direction for testing and implementation outlined in the January 1995 Working Paper. It served to generate thought, discussion and general principles to encourage flexibility and innovation in the design and servicing of new neighbourhoods. In some cases, the test case was sufficient to establish the principles outlined in Section 2 which can be implemented through future neighbourhood land use plans. In other cases the redesign served as one test which now requires more detailed work by the responsible part of the administration to further refine and review engineering details and make appropriate changes to policy or standards.

The following actions summarize the next steps needed to implement or further review and implement the various principles.

1. That the Suburban Neighbourhood Design Principles be immediately communicated to all land developers and planning and engineering consultants working within Edmonton to encourage their use in the design of new neighbourhoods.

   While some of the following actions reflect a need for further work in some areas, it is appropriate that all of the Principles be promoted for implementation. Through their use in real neighbourhood planning, many of the servicing standards questions can be resolved.

2. Effective immediately, that the Suburban Neighbourhood Design Principles outlined in Section 2.0 be used by the City of Edmonton administration and Council as a guide in assessing the design and servicing of new neighbourhoods.

   The test case indicates that some land efficiencies and cost savings are possible through the application of the Principles. Moreover, an acceptable living environment is still achieved.

3. That the Suburban Neighbourhood Design Principles be considered in the preparation of suburban planning related portions of the Municipal Development Plan (to replace the General Municipal Plan).

   Since preparation of the January 1995 Working Paper, the amendments to the Municipal Government Act replacing the Planning Act have been passed and came into effect September 1995. The amendments require the replacement of the General Municipal Plan (GMP) with a Municipal Development Plan (MDP). It is therefore appropriate that the Principles be considered in the new MDP.

4. That, by April 30, 1996, the review of the residential districts of the Land Use Bylaw currently underway by the Suburban Planning Section of Planning and Development be completed to allow and encourage intensification, cluster housing and alternatives for building site requirements. (Principle 15)

The Land Use Bylaw currently makes development of low density housing in non-traditional settings difficult to achieve. Residential districts are being reviewed to make alternative settings easier to achieve under the bylaw. The intent is clearly to allow for greater use of land and infrastructure while maintaining a good living environment - not to develop substandard housing or settings.

Since 1991, City Council has had a guideline promoting between 15 and 35 percent of units in a neighbourhood to be multi-family units, in order to achieve heterogeneous new residential areas at the ASP and NSP levels. The existing community of Sweet Grass includes 58 percent multi family with Blue Quill containing 74 percent and Blue Quill Estates 55 percent. The redesign stays within Council's guideline with 34 percent of units east of 119 Street multi family and 22 % of lots west of 119 Street multi family. The neighbourhoods still have more units in the redesign due to intensification of single family on smaller lots than the existing neighbourhoods.

There may be benefit to a review of the housing mix proportions in new residential developments in order to allow intensification through either a higher percentage of multi-family units or through the intensification of low density residential districts.

5. That, by December 31, 1996, further review of road standards, including underground utility placement, be undertaken to allow roads to be designed for their intended purpose without excess land or servicing costs. This must be undertaken considering recommendation 4 above. As part of this review, sidewalks on both sides of residential streets with boulevards provided at least on neighbourhood entry streets will be considered. (Principles 3, 4, 5 and 6)

   In the redesign, all internal roads were assumed to be 9 m carriageways on a 17 m right-of-way. This is smaller than many roads within the existing neighbourhoods. The traffic analysis of the redesign showed that these roads could accommodate the attendant traffic generated. It did not consider whether further reductions are possible and still accommodate traffic and parking.

   The issue of transporting special needs students and program of choice students must also be considered in this review.

   Further review of road standards should take place to determine if further reductions are possible. This should include an assessment of the inclusion or exclusion of lanes. It should complement the review of siting requirements under the Land Use Bylaw.

   Many of the changes introduced to the neighbourhoods through the redesign result in a more compact and cohesive plan intended to promote pedestrian and bicycle movement throughout the neighbourhood and to the periphery of the neighbourhood. It is therefore important that provision of sidewalks be a key consideration in order to increase the ease with which pedestrian movements can occur.

6. That current Transit service policy be revised to allow adequate service without requiring the additional costs associated with Transit service internal to the neighbourhood. (Principle 6)

   This is difficult to test in the context of the redesign since the true impacts on cost and operational efficiency would take place in a larger context such as an entire ASP or SCDB area. Perhaps a test area within a new or newly developing area could be used to determine appropriate policy changes for application City wide.

7. That all neighbourhood and subdivision designs ensure direct pedestrian access to exterior transit routes through the use of streets and walkways. (Principles 5 and 6)

8. That, by December 31, 1996, parks and open space standards be reviewed to explore opportunities to accept dispersed open space within neighbourhoods. Prior to completion of this review, proposals will be entertained through NSP's/NASP's if submitted. (Principle 9 and 10)

   The redesign contains considerably less MR land than the existing neighbourhoods. Yet, the redesign presents a neighbourhood with many opportunities to use and develop open areas for informal recreational enjoyment because of the interconnectedness of MR land, storm water management facilities and power line rights-of-way. This could be further augmented by including more formal "pocket parks" in neighbourhoods where the advantage of such rights-of-way do not exist. The review must include an assessment of maintenance costs and explore innovative ways of funding any increased maintenance costs.

9. That, by December 31, 1996, the Drainage options outlined on Table 1 in Section 2.0 of this report be explored in greater detail to provide additional options for storm water management with appropriate amendments to the Servicing Standards Manual. Prior to completion of this review, proposals will be entertained if submitted by the private sector. (Principle 13)

   The redesign tested the option of dual use of storm water management facilities and parks sharing land. It also assumed development of combination wet lands with dry areas. Table 1 outlines other options for managing storm water which need to be examined in greater detail to create further options and opportunities through the Servicing Standards Manual.

10. That, by December 31, 1996, current practices, policies and bylaws of the Drainage and Water Branches regarding the use of public utility lots rather than easements be reviewed with a view to reducing maintenance and administrative costs to the City. (Principle 14)

    Public utility lots can be costly due to their maintenance costs and/or administrative costs of leasing the PUL's to adjacent property owners. In many cases, easements could serve to protect the utilities and provide access for maintenance when needed reducing the costs associated with PUL's.

11. That concerns relative to safety, liability, health, maintenance and supervision within dual use areas be reviewed and addressed. (Principle 10)

    Where dual use of SWMF and parks exist, particularly in proximity to schools and playgrounds, concerns as noted above have been raised. The testing of dual use through pilot projects is an appropriate vehicle to address these concerns.

12. That the Public and Separate School Boards continue to explore opportunities for the joint use of school facilities such as libraries, gymnasiums and playfields with the intention of building such projects at the earliest possible opportunity.

[1] Suburban Neighbourhood Densities Research Project January 1995
[2] Suburban Neighbourhood Design Working Paper January 1995

Selected Bibliography

Alberta Municipal Affairs. *Residential Subdivision Servicing and Design Practices: Reference Manual*, 1986.

Alberta Municipal Affairs. *Natural Network Subdivision*, 1991.

American Planning Association Journal. *Twentieth Century Land Use Planning - A Stalwart Family Tree*. Edward J. Kaiser and David R. Godschalk, Summer 1995.

American Planning Association. *Rules Made to Be Broken*. Ruth Eckdish Knack, November 1998.

American Society of Civil Engineers, (ASCE). *Residential Streets (2nd Edition)*. National Society of Civil Engineers - the Urban Land Institute, 1990.

BC Transit. *Transit and Land Use Planning*.

Calthorpe, Peter. *The Next American Metropolis*. New York: Princeton Architectural Press, 1993.

Canadian Mortgage and Housing Corporation. *Achieving Infrastructure Cost Efficiency/Effectiveness Through Alternative Planning Approaches*, June 1992.

Canadian Mortgage and Housing Corporation. *Changing Values, Changing Communities - A Guide to the Development of Healthy, Sustainable Communities*, January 1995.

Canadian Mortgage and Housing Corporation and Regional Municipality of Ottawa-Carleton. *Infrastructure Costs Associated with Conventional and Alternative Development Patterns*. Essiambre Phillips Desjardins Associates Ltd., 1995.

City of Calgary. *Sustainable Suburbs Study: Creating More Fiscally, Socially and Environmentally Sustainable Communities*. Planning and Building Department, 1995.

City of Edmonton. *Conservation of Natural Sites in Edmonton's Table Lands Policy*. Planning and Development Department, 1995.

City of Edmonton. *Design Guide for a Safer City*. Planning and Development Department, 1995.

City of Edmonton. *Dual Use of Storm/Park Sites for Dry Pond Stormwater Management - Discussion Paper*. Parks and Recreation Department, February 24, 1994.

City of Edmonton. *Stormwater Management Facilities Guidelines Review*. Planning and Development Department, 1995.

Corporation of the District of North Vancouver. *Creating a Shared Vision: A Framework for Neighbourhood Liveability and Involvement*, 1994.

ITE Journal. *A Logit Model of Public Transport Route Choice*. John Douglas Hunt, December 1990.

Ontario Ministry of Housing. *Making Choices - Alternative Development Standards - Guideline*. Marshall Macklin Monaghan Limited; Berridge Lewinberg Greenberg Ltd.; REIC Ltd., 1994.

Ontario Ministry of Housing. *Urban Development Standards, Part I Engineering Standards and Costs and Part 2 Planning Standards*. Marshall Macklin and Monaghan Limited, 1990 Update.

Ontario Ministry of Municipal Affairs and Ministry of Transportation. *Transit-Supportive Land Use Planning Guidelines*, 1992.

Ontario Planning Journal, Vol. 6, No. 2. *Reducing Housing Costs by Optimizing Infrastructure*. Henry Borgdorff, P. Eng., May/June 1991.

Regional Working Committee on Alternative Urban Development Standards. *Alternative Development Standards - Proposals to Reduce Housing Costs*, 1991.

Roseland, Mark. *Toward Sustainable Communities*. Ottawa: National Roundtable on the Environment and the Economy, 1992.

Transportation Association of Canada. *A New Vision for Urban Transportation*, 1993.

United States Department for Housing and Urban Development. *Affordable Housing Development Guidelines for State and Local Government*, November 1991.